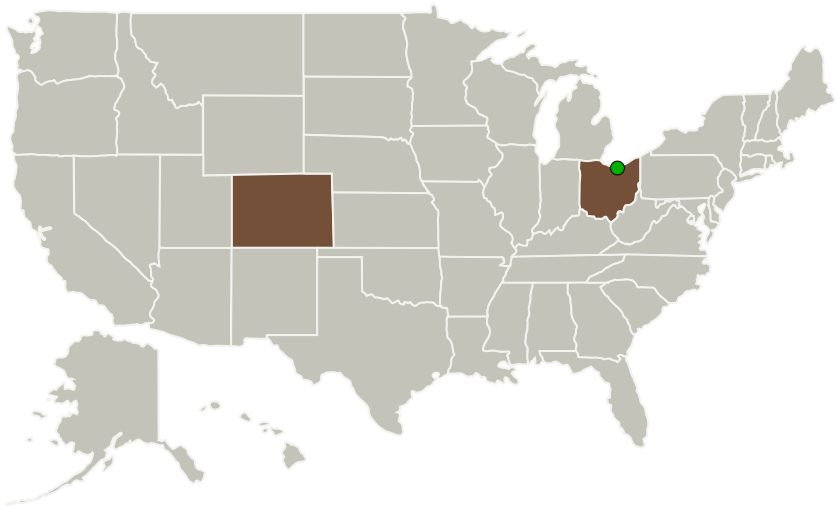
Wrapped-MLI: Thermal Insulation for Cryogenic Piping, Phase II

Completed Technology Project (2011 - 2013)

Project Introduction

New NASA vehicles (EDS, Orion, landers & orbiting fuel depots) need improved cryogenic propellant transfer & storage for long duration missions. Current cryogen feed line Multi-Layer Insulation (MLI) performance is 10X worse per area than tank MLI insulation. Cryogenic piping heat leak is 50 ⬭ 80% of cryotank heat leak, and 40 ⬭ 50% of LH2 is lost - about 150,000 gallons ($300,000) - during transfer, chill down & ground hold during each STS launch. Quest Product Development, teaming with Ball Aerospace, proposes to continue development of an innovative advanced insulation system, Wrapped MLI, which could provide improved thermal insulation for cryogenic feed lines. Wrapped MLI (wMLI) is high performance multilayer insulation designed for cryogenic piping that uses Quest's innovative discrete spacer technology to control layer spacing/density and reduce heat leak. The Phase I program successfully proved wMLI feasibility by designing, building and testing a wMLI prototype with a measured heat leak 3.6X lower than spiral-wrapped conventional MLI widely used for piping insulation. A wMLI prototype had a heat leak of 7.3 W/m2, or 27% of the heat leak of conventional MLI (26.7 W/m2). Modeling estimates the thermal performance of wMLI could be further improved by 3-fold, leading to a heat leak of 0.7 W/m2 (20 layers, 77K to 295K), and even larger advantages over conventional MLI piping insulation. In a Phase II program we would further develop wMLI technology with custom, molded polymer spacers, and advance the product toward commercialization via a rigorous testing program including developing advanced vacuum insulated pipe for GSE application. wMLI could provide advanced cryogen transfer line insulation and be the basis of a superior Vacuum Insulated Pipe technology.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Quest Thermal Group	Lead Organization	Industry	Arvada, Colorado
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Colorado	Ohio

Project Transitions

June 2011: Project Start

May 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139559)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Quest Thermal Group

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

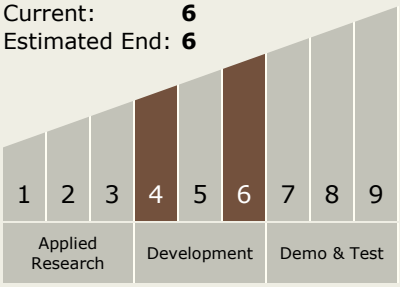
Carlos Torrez

Principal Investigator:

Scott A Dye

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.2 Launch Vehicle Propellant

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System